



RESEARCH DEPARTMENT

REPORT

**Subjective evaluations of recent
productions of television
with stereophonic sound**

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**SUBJECTIVE EVALUATIONS OF RECENT PRODUCTIONS OF
TELEVISION WITH STEREOPHONIC SOUND**

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Summary

A series of subjective tests has been conducted to assess the improvement given by stereophonic sound with television in comparison to the conventional monophonic equivalent. The test material consisted of extracts from eight, recently produced, television stereo programmes. They represented the wide range of BBC television programme output and, since some types of programme were new to television stereo, their production by this means was obviously experimental. Both technically and non-technically qualified people took part in the tests but, with a few exceptions, they returned similar subjective responses.

The tests showed a marked preference for the stereo presentation. Of the eight programme extracts, five gained an average of two subjective grades of improvement. These items fell into the categories of music, sport and science fiction. The remaining programmes only benefitted marginally from stereo.

The subjects' criticisms have suggested some modification of production techniques and it can be expected that as these are refined, viewers' enjoyment of television programmes will be further enhanced by the television stereo presentation.

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1. Introduction

During the past ten years, public exposure to BBC television stereo has been limited to the occasional "simulcasts" where the stereo sound is transmitted by one of the v.h.f. radio networks and the mono sound and video by one of the television networks. These programmes have been restricted to concerts of classical or pop music where the sound balance remains more or less unchanged during each piece of music. Indeed, the stereo balance is most likely to have been provided by the appropriate Radio production department whilst the vision and mono sound to have been produced separately by a television production department. Based on returns received by BBC audience research, such simulcasts have been very well received by the public despite the not insignificant fraction of people who arrange their loudspeakers and television in unorthodox fashion.

Clearly, the need for two broadcasting networks (one television, one radio) is uneconomic and the type of programme which can thus be broadcast is restricted. A number of transmission methods are currently being investigated to enable the public to receive stereo sound with television on a regular basis. Research Department is assessing ways of inserting a second audio channel into the existing terrestrial television broadcasting network.¹ The BBC also has plans to commence Direct Broadcasting by Satellite (DBS)² in 1986 by which each video channel could be accompanied by up to eight digital audio channels. Cable Television could be used to distribute stereo sound with television to the home and stereophonic video discs and cassette recorders already exist.

The type of programme broadcast as a simulcast has tended to be restricted to music since it needs to be compatible as a sound-only programme for radio listeners. However, concerts and opera form only a small fraction of television programme output. Experimental productions have suggested that many types of programme including light entertainment, sport and drama could benefit from stereo and a number of programmes of various types have recently been produced in stereo (although transmitted in mono). Stereo sound production methods were developed for radio in the 50's and 60's^{3,4} and many are common to television stereo. However, television stereo often makes special demands and

new sound production methods are being evolved to meet them.⁵

Interest in television stereo has also been growing abroad. Enquiries within the EBU have indicated that no less than 17 countries have at least experimented with the medium. Japanese⁶ and German⁷ broadcasters have taken a step further and are broadcasting television stereo programmes on a more regular basis using a two-sound carrier plus video modulation system for transmission.

In preparation for a possible future television stereo service, the opportunity has been taken to run a comprehensive series of in-house tests to assess the effectiveness of the recently produced, experimental programmes. This Report describes these tests and presents their results.

2. General Considerations

2.1. The medium of television stereo

One of the main aims of the tests was to establish how successful is the medium of stereo sound with television by comparison with mono sound with television. However, the medium can not be divorced from the message and viewers' enjoyment and appreciation of a programme is based on a complex web of many factors. For the present discussion, these factors may be crudely divided into three categories, namely programme content (sport, light entertainment etc.), production methods (sound balance) and the listening and display equipment (two loudspeakers and a television screen).

During both programme production and programme viewing, these factors interact in a complex fashion and it is difficult to identify how much any one factor contributes to, or detracts from, the success of the programme. For the tests therefore, some degree of objectivity on the part of the viewer was desirable. It was found, in fact, that viewers did have some difficulty in judging the improvement given by the stereo presentation if they were not interested in the programme. When this occurred, their response tended to be neutral, i.e. no difference. On the other hand, the wide range of programme types used as source material helped avoid this condition.

The means of reproduction of sound and vision was also subject to a number of variables such as the positions of the loudspeakers in relation to the television screen, and their size and quality. The system chosen was designed to give high-quality sound reproduction using commercial units (described in detail in Section 3.2.), readily available to the home viewer.

2.2. Production methods

The way in which the sound is balanced for television stereo programmes is an extensive subject in itself but, in general terms, it may be said to fall into two overlapping categories. The first, familiar in simulcasts, is prevalent in music concerts of most kinds. During each piece of music, the sound balance and the apparent aural locations of the sound sources remain more or less fixed with time whilst the pictures change. In most cases, the sounds are balanced to fill most of the stereo sound stage. Past experience, based on audience research figures and brief Research Department tests, has suggested that once the viewer has acclimatised himself/herself to the sound balance not changing with the picture, appreciation of the programme can benefit greatly from the stereo sound.

The second category of sound balance applies to much the larger proportion of television programme output. The sound is now balanced and panned to match the visual cues of the picture. Such an approach is applicable to many types of programme such as drama, light entertainment and sport. With this approach, it is not necessary that the aural sound image positions exactly coincide with the visual image positions. Some leeway is tolerable and indeed often desirable. The sound and vision are complementary and the two interact positively to create an overall effect which is "the show".

Some programmes like opera are such that a mixture of the two approaches is suitable. With the orchestra out of sight, the orchestral sound can be mixed to fill the stereo stage and the balance can remain fixed. On the other hand, the singers' voices can be positioned according to their visual positions on the screen.

3. Test arrangements

3.1. General

In order to avoid the temptations of making the tests too "technical" or of posing tendentious questions, the tests were made as simple as possible.

Viewers were presented with extracts from eight programmes, each one lasting between 4 and 8 minutes. They were asked to judge their preference for the television stereo presentation by comparison with their normal experience of conventional mono and mark it according to the 7-point CCIR preference scale. Comments were also invited. The tests were divided into two parts, each one lasting less than half an hour. The Appendix shows a copy of the questionnaires used.

Viewers were only able to listen to the stereo sound and were not given a switch to listen to the corresponding mono sound. The reason for this was to encourage the viewer to "sit back and enjoy" the programme as he/she would do at home, and avoid a simplistic comparison of the aural and visual image locations. These locations are technical parameters which, although of interest, could distract the viewer from an overall appreciation of the programme.

To give the viewer the best stereo listening position, only one subject at a time took part in each test. The viewer was asked to exclude from his/her assessment the improvement in tonal quality due to the high quality loudspeakers being used. Most viewers would be accustomed to the usually poor sound quality of domestic television sets and it was found at an early stage that the high quality sound reproduction of the loudspeakers used (see below) greatly enhanced viewers' programme enjoyment.

Although the loudspeaker level and left-right balance controls were preset to give good stereo, viewers were free to adjust them during the programme to suit their own tastes. Volume and balance controls are standard features on domestic stereo "hi-fi" systems and it was felt sensible to provide them here. It transpired however, that very few viewers made any changes to the preset levels during the tests.

Two groups of viewers each numbering about 16 took part in the tests. The first were engineers and technicians, many of whom had experience of subjective tests of various kinds. The second group consisted of inexperienced staff at Research Department such as members of Drawing Office, Photographic Unit, Workshops, secretaries and maintenance staff. In so far as the second group was not likely to have specialised engineering knowledge relevant to the tests, it was hoped it would be more representative of the public at large.

3.2. Means of reproduction

Figs. 1 and 2 show respectively a plan view and a photograph of the test arrangement. The

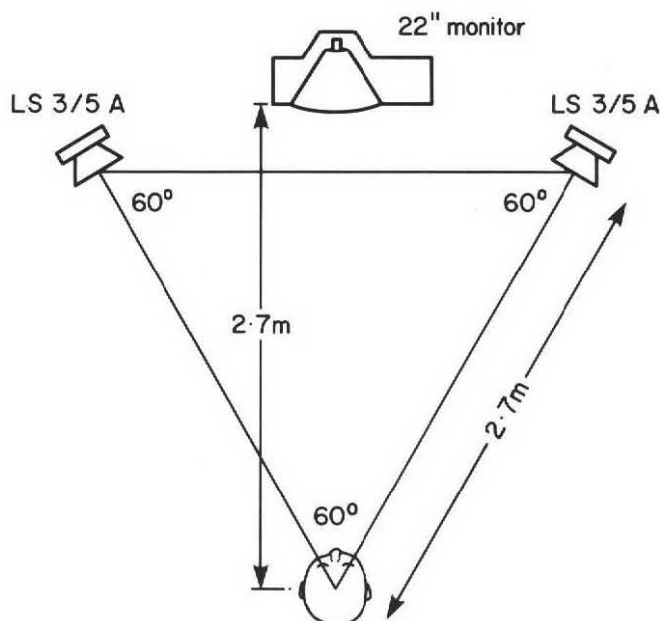


Fig. 1 — Plan view of reproduction arrangement.

video monitor was a commercial, 22" colour monitor and the loudspeakers were BBC LS 3/5 A's which are high-quality, "book-shelf", monitor loudspeakers⁸. Such a small loudspeaker was chosen because earlier experiments had suggested that the physical presence of two larger loudspeakers tended to "intimidate" the picture. The loudspeakers subtended an angle of 60° at the viewer. 60° is the recommended angle for stereo listening and indeed, this is the preferred configuration in television production areas. However, it was appreciated that some viewers, for reasons of convenience or the nature of television stereo, may prefer a narrower angle and this is discussed later in Section 4.

The distance of the viewer from the screen was eight times the picture height. This distance is greater than the factor of six recommended by the CCIR for critical viewing but it was found to be a more pleasant viewing distance for television stereo, it is more typical of domestic viewing, and the tests were not aimed at critical picture assessment.

The room in which the tests were held was a listening room normally used for the critical assessment of loudspeakers. It is designed to



Fig. 2 — Reproduction of television stereo.

match a typical domestic living room but with a well balanced acoustic and a slightly shorter than typical reverberation time. Its dimensions are 5.4 m x 4.2 m x 2.8 m and it has an average reverberation time of 0.26 seconds.

3.3. Programme material

The test programme extracts were pre-recorded on a 'C' format tape recorder capable of recording video and broadcast quality stereo sound. The test tape was produced* with two objects in mind. One was to provide suitable source material for the subjective tests and the other was to make up a demonstration tape to show the variety and scope of television stereo programmes. The tape consisted of eight extracts from different programmes. Their duration varied between four and eight minutes. Each extract was introduced by a short preview (voice over a still shot) to prepare the viewer for the next extract and prevent "cultural shock".

The programme extracts may be summarised as follows:-

1. Playschool
 - Children's programme. The action is simple with the presenters talking to camera. Music is provided by a small off-stage band which was balanced to fill most of the stereo stage.
2. Blake's Seven
 - Action-packed science-fiction drama. Effects are fully exploited by the stereo presentation. Many scenes involve actors on set and their voices are positioned in the stereo stage to fit in with the visual imagery.
3. James Galway
 - A studio orchestra accompanies the "man with the golden flute" in two short pieces. The sound balance remains more or less fixed.
4. Sportsnight
 - Harry Carpenter presents football and boxing matches, both of which are before

crowds in good voice. The crowd noises fill the stereo stage to good effect.

5. The Hitch-hiker's Guide to the Galaxy
 - Imaginative science-fiction tale of "Arthur Dent's travels through hyperspace." BBC Radiophonic Workshops created special sound effects and electronic music for the programme. In scenes where actors are present on set, their voices are positioned in the stereo stage to fit in with the visual imagery.
6. The Love of Three Oranges
 - Studio production of Prokofiev's light opera. The orchestral sound is arranged to fill the stereo stage whilst the singers are placed to conform with their visual images.
7. Play for Today - 'Sorry'
 - A play about two rather different women who share an office and a difficult boss. It rests heavily on the dialogue and no assistance is given by incidental music or special sound effects. Effects such as they occur are "live" sounds from the set such as typing, a kettle boiling, a creaking chair etc. The stereo presentation is exploited to support and reinforce the dialogue. This was perhaps the most innovative and experimental of the productions.
8. Oscar Peterson
 - Studio show with audience consisting mainly of two pieces of jazz featuring Oscar Peterson on piano, accompanied by bass and drums. The piano dominated the stereo sound stage whilst the other instruments were positioned to complement the general visual presentation.

4. Results and discussion

4.1. Results

Table 1 shows the mean and standard deviation of viewers' preferences for each of the programme extracts. As might be expected for tests of this kind, there was considerable divergence of opinion as indicated by the high standard deviations. Nevertheless, five of the eight programme items (numbers 2 to 6 inclusive) achieved nearly two grades of improvement on the CCIR preference scale (i.e. "better than") and the

* The tape was arranged and compiled by R.M. Angel at BBC Television Centre and the stereo sound for the eight programme extracts was produced by him and by other BBC television sound supervisors.

Mean (standard deviation) based on CCIR preference scale

Part 1 ITEM	1 PLAYSCHOOL	2 BLAKE'S SEVEN	3 JAMES GALWAY	4 HITCH- HIKER'S GUIDE	5 SPORTSNIGHT
Expert Viewers	0.8 (1.6)	1.6 (1.6)	1.6 (1.1)	2.0 (1.1)	1.6 (1.3)
Inexpert Viewers	1.2 (1.0)	1.9 (1.4)	2.0 (0.9)	1.8 (1.0)	1.7 (1.3)
All Viewers	1.0 (1.9)	1.8 (2.1)	1.8 (1.4)	1.9 (1.5)	1.7 (1.8)

Part 2 ITEM	6 LOVE OF THREE ORANGES	7 SORRY	8 OSCAR PETERSON	OVERALL (PARTS 1 & 2)
Expert Viewers	1.8 (1.0)	0.0 (1.4)	0.9 (1.6)	1.3 (0.7)
Inexpert Viewers	2.2 (0.6)	1.7 (1.1)	2.3 (0.9)	1.9 (0.3)
All Viewers	2.0 (1.2)	0.9 (1.8)	1.6 (1.8)	1.6 (0.8)

Table 1 : Subjective Test Results

CCIR preference scale	Numbers of viewers	Part 1	Part 2
+3 Much better than	Expert	19	16
+2 Better than			
+1 Slightly better than	Inexpert	17	13
0 Same as			
-1 Slightly worse than			
-2 Worse than			
-3 Much worse than			

overall averages were 1.3 and 1.9 grades respectively for the expert and inexpert viewers. This reflects the general reaction of most viewers that the stereo sound definitely increased their enjoyment of the programme. Only a minority found that the stereo sound gave no improvement or actually detracted from the programme. Of the remaining three items, the two groups of viewers returned conflicting answers on items 7 and 8 and, for item 1, both groups of viewers estimated only one grade of improvement.

In general, the differences between the

results of the expert and inexpert viewers were not statistically significant. There were two exceptions. The inexpert viewers preferred the last two items (the play "Sorry" and the Oscar Peterson show) by about two grades whilst the expert viewers only barely preferred them. These differences are not readily explainable but may simply have been due to the expert viewers being more sensitive to shortcomings of the programme item.

It is probable that the averages returned would have been higher if viewers had been shown

only those programmes they enjoyed. A number of viewers found it difficult to judge the beneficial effects of the stereo sound when they did not enjoy the programme. When this was the case, some gave a neutral answer (near 0) and this tended to reduce the overall average.

The criticisms and comments made by the viewers fell broadly into categories according to the type of presentation and sound balance. So, the success or otherwise of the stereo sound presentation is discussed according to the main features of the sound balance and particular programme items are only quoted as examples.

4.2. Fixed sound balance

Three of the eight programme items – James Galway, "The Love of Three Oranges" and the Oscar Peterson Show – had a more or less fixed sound-stage. The music in stereo impressed viewers to varying degrees according to the quality of the stereo sound balance. Accordingly, "The Love of Three Oranges" and the James Galway item were both successful (2.0 and 1.8 grades, respectively). However, the balance for the Oscar Peterson trio was less well liked mainly because the piano sound was too wide and the drums were wrongly located (0.9 grades, expert viewers; 2.3 grades, inexpert viewers).

Although all three extracts had a nominally fixed sound-stage, there were other factors which subtly affected the overall performance. With the James Galway item, the orchestra and soloist were in full view and the camera moved from the soloist to particular groups in the orchestra. So, it was clear to the viewer that the sound and vision were not intended to match one another, image for image. Whilst viewers quickly acclimatised themselves to this approach and enjoyed the programme, a number of viewers found the stereo sound so impressive that the vision took a secondary role. This led to comments like "stereo sound plus added vision". On the other hand, the orchestra in "The Love of Three Oranges" was not visible and the soloists were panned slightly off the centre of the sound stage to conform with their positions on the screen. In this case, sound and vision took equal roles and the combination was successful. As well as the sound balance for the Oscar Peterson trio drawing some criticism, a further factor that could have led to a degree of aural/visual conflict was that the trio occupied a small physical space and the camera shots were close-up. This highlighted the contrast between the fixed sound balance and the changing picture and could have caused some conflict to the viewer.

Incidental music featured in a number of the other programme items (Playschool, "Blake's Seven", "Hitch-Hiker's Guide"). The musicians were of course not visible and apart from the occasional comments that the stereo stage was too wide, the stereo presentation of the music was thought to be successful.

4.3. Ambience and special effects

Two aspects of the stereo sound that contributed greatly to viewers' appreciation of the programme were the special effects, especially in "Blake's Seven" and the "The Hitch-hiker's Guide", and the sense of ambience and space captured by the stereo presentation. Both of the science-fiction programmes were ideal material for special sound effects and their impact was greatly enhanced by stereo. Battle-scenes in "Blake's Seven" for example, fully exploited this new potential.

The programme where the sense of ambience and spaciousness was most impressive was Sportsnight. The crowd noises in the football and boxing enhanced viewers' sense of involvement and, by using the full stereo stagewidth, viewers were enveloped by the sound of the crowd, as they would be in reality.

"Playschool" also benefitted from the stereo ambience but in a more subtle way. Here, the sense of space in the studio was heightened. This brought with it, however, the disadvantage that viewers were also more sensitive to extraneous studio noises such as a creaking chair, camera fans and ventilation. Although, this observation was reserved to this particular programme item, it is an effect that could reoccur in future productions of this kind.

4.4. "Live" sounds on set

Scenes involving artists on set represented a large proportion of the programme extracts viewed. "Playschool" and "Sportsnight" both had presenters talking to camera and the play "Sorry" and parts of "Blake's Seven" and "The Hitch-hiker's Guide" contained extensive dramatic scenes.

A presenter talking directly to camera posed no difficulties to the viewer and indeed was little different to conventional mono. However, in the majority of scenes, there was more than one artist on set with at least one of them off the centre of the screen. It was difficult to judge from viewers' comments how successfully the aural and visual images were normally matched. There

were many occasions when the match was not convincing and viewers were then disturbed. Such occasions left a lasting impression on the viewer to the detriment of scenes where the balance was successful.

The most demanding scenes were ones where several artists were on set and the camera shots changed regularly. Viewers were distracted by sudden leaps in the position of an artist's voice even if this was dictated by a change of shot. Also, if two artists were both on screen, viewers found that positioning the voices anywhere other than close to the screen was implausible and unpleasant.

These effects were noticed particularly in the play "Sorry". With no incidental music, voice-over or special effects, all the sounds were "live" and had a related visual image; so voices, the sounds of footsteps, a kettle boiling and a telephone ringing had related visual images either in or out of shot. This posed greater demands on the positioning of sounds in the stereo stage and the desired effect was not always achieved. One example occurred when the manager in the play walked across the set whilst talking. As he did so, the sounds of his footsteps and his voice were not coincident in the stereo stage and this was noticed by a number of viewers.

It appears that whereas the television viewer has acclimatised himself/herself to camera shots changing rapidly between widely different angles and perspectives, the same cannot be said of the equivalent in sound. Acclimatisation can take time and it is possible that when viewers have seen a significant number of "drama" programmes in stereo, they will no longer be troubled in the way described. However, it may be a continuing difficulty, and on the evidence of the current tests, it would appear preferable in most circumstances to restrict the positions of voices of artists on set to within a small distance of the screen. Interestingly, this approach was suggested for television stereo as long ago as 1960.³ Some experimentation with balancing methods is clearly desirable.

4.5. Stereo stage width

The 60° stage width used in the subjective tests was relatively wide and it was anticipated that the wide sound stage might contrast deleteriously with the narrow television screen. There were some viewers' comments of an overwide sound stage but these could be traced to a particular balancing technique. The 60° stereo configuration is that

used during programme sound production and it is possible that in some instances, it may have been preferable to reposition the sound images. However, for the majority of programme extracts and viewers, the 60° configuration gave satisfactory results. If a viewer does prefer a consistently narrower sound stage, the loudspeakers may of course be moved towards the screen.

5. Conclusions

The series of subjective tests has shown clear support from both technically experienced and inexperienced viewers for stereo sound with television. Five of the eight programme extracts assessed by the viewers gained two grades of improvement by the stereo presentation. Of the eight extracts five were of an experimental nature and had not been produced in stereo before and three were musical, produced in a manner similar to that employed for television and radio simulcasts i.e. with a nominally fixed sound stage.

Reflecting the public's enthusiastic response to simulcasts, viewers who took part in the tests definitely preferred the stereo sound of two of the three music items (James Galway and Prokofiev's opera "The Love of Three Oranges"). However, only a qualified preference was shown for the Oscar Peterson show, largely because the stereo mix was less well liked.

Two of the five experimental productions were science-fiction dramas ("Blake's Seven" and "The Hitch-hiker's Guide to the Galaxy"). These were both successful largely as a result of the special sound effects and incidental music in stereo. Some criticisms were made however of scenes in which several actors were present. It became clear that the way the voices are positioned in the stereo stage and their relationship to the visual imagery are critical. In a number of scenes the interplay between sound and vision broke down and viewers found the scenes disturbing. This was more evident in the play "Sorry" which did not have any special effects or incidental music. Some of the difficulties in balancing the sound for drama were highlighted and viewers stated only a marginal preference for the stereo presentation; inexperienced viewers, however, still preferred the stereo despite these criticisms. In the light of these comments, further experimental productions of drama in stereo are clearly desirable.

The last extract was Sportsnight and the accompaniment of large crowds reproduced in full-width stereo to pictures of football and

boxing was highly effective. Viewer involvement and the sense of atmosphere were greatly heightened by the stereo presentation.

It is a significant indicator of future trends that despite the experimental nature of some of the programme extracts, most were definitely preferred in stereo. As production methods are refined and viewers become accustomed to television stereo presentation of a variety of programmes, it can be expected that this preference will increase.

6. Acknowledgements

The author wishes to thank R.M. Angel and other sound supervisors at BBC Television Centre not only for preparing the programme items and test tape, but also for many useful discussions on studio operations.

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Appendix

Questionnaire for television stereo tests

You are about to see extracts from a number of television programmes produced with stereo sound. The extracts vary in duration and each is preceded by a short, introductory trailer to set the scene.

Using the comparative scale below, you are asked to judge by how much your enjoyment of each programme extract is enhanced by being presented with stereo (instead of mono) sound. Space is left for any comments you may wish to make.

CCIR Comparative Scale

+3 Much better than		–3 Much worse than
+2 Better than		–2 Worse than
+1 Slightly better than		–1 Slightly worse than
0 Same as		

Name Date

Part 1

1. Playschool (4'54")
Comments:
2. Blake's Seven (7'50")
Comments:
3. James Galway (6'42")
Comments:
4. Sportsnight (7'15")
Comments:
5. The Hitch-Hiker's Guide to the Galaxy (4'42")
Comments:

Part 2

6. The Love of Three Oranges (8'02")
Comments:
7. Play for Today – Sorry (9'14")
Comments:
8. Oscar Peterson (5'00")
Comments:

